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Cyclopoid Copepods of the Genus *Paranthessius* Associated with Marine Pelecypods in Chile

By Arthur G. Humes [1]

Records of the genus *Paranthessius* from the western coast of North and South America are relatively scarce. Thompson (1897, p. 87) in Herdman, Thompson, and A. Scott, described *Pseudolichomolgus columbiae* (=*Paranthessius columbiae* according to Illg, 1949) from a single planktonic specimen in Puget Sound, Washington. Illg (1949) reported five species of *Paranthessius* from various pelecypods in California: *P. columbiae* (Thompson, 1897) from *Schizothaerus nuttalli* (Conrad) and *Protothaca tenerrima* (Carpenter), and four new species, *P. panopeae* from *Panope generosa* Gould, *P. tivelae* from *Tivela stultorum* (Mawe), and *P. saxidomi* and *P. perplexus* from *Saxidomus nuttalli* Conrad.

On Cruise 18 of the R/V *Anton Bruun*, during the Southeastern Pacific Biological Oceanographic Program of the National Science Foundation, the ship visited Valparaiso and Iquique, Chile, where the author collected specimens of the two new copepods described below from pelecypods purchased in the local fish markets. The first of the new species is the second record of *Paranthessius* from the genus *Protothaca* and the second represents the first record from *Mesodesma*.

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The discovery of these two new copepods extends the eastern Pacific range of the genus as far south as central Chile.

The study of the specimens has been aided by a grant (GB–5838) from the National Science Foundation.

All figures have been drawn with the aid of a camera lucida. The letter after the explanation of each figure refers to the scale at which it was drawn. The abbreviations used are: A_1=first antenna, A_2=second antenna, L=labrum, MD=mandible, P=paragnath, MX_1=first maxilla, MX_2=second maxilla, MXPD=maxilliped, and P_1=leg 1.

I thank Prof. José Stuardo of the Universidad de Concepción, Concepción, Chile, for the identifications of the two pelecypod hosts.

Family Lichomolgidae Kossmann, 1877

Genus *Paranthessius* Claus, 1889

Paranthessius protothacae, new species

Figures 1–33

Type material.—11 ♀♀ and 10 ♂♂ from the mantle cavity of 59 *Protothaca thaca* Molina purchased in the fish market at Iquique, Chile, Aug. 23, 1966. (These pelecypods probably came from Punta Guanillos, 21°15′S, 70°07′W, south of Iquique.) Holotype female, allotype, and 16 paratypes (8 ♀♀, 8 ♂♂) deposited in the United States National Museum, and the remaining paratypes (dissected) in the collection of the author.

Female.—Body (figs. 1, 2) moderately slender, about three times longer than wide, with prosome not greatly thickened dorsoventrally. Length (not including setae on caudal rami) 1.62 mm (1.47–1.78 mm) and greatest width 0.54 mm (0.50–0.61 mm), based on 10 specimens measured in lactic acid. Dorsoventral thickness of prosome about 0.45 mm. Ratio of length to width of prosome 1.9:1. Segment of leg 1 separated from head dorsally and laterally by a distinct furrow. Epimeral areas of metasomal segments as illustrated.

Segment of leg 5 (fig. 3) 91μ x 135μ. Between this segment and genital segment a weak ventral intersegmental sclerite, its sclerotization more evident laterally (fig. 4). A median prominence in front of segment of leg 5 (figs. 4, 5). Genital segment as long as wide, 216μ x 216μ, in dorsal view anterior half laterally expanded with rounded margins and posterior half narrower and tapering slightly posteriorly with straight margins. Areas of attachment of egg sacs located dorsolaterally, each area (fig. 6) bearing small seta 13μ long and spiniform process 6μ. Three postgenital segments 78μ x 120μ, 70μ x 109μ, and 114μ x 99μ, from anterior to posterior. Anal segment with posteroventral margins unornamented.

Caudal ramus (fig. 7) elongated, 135μ x 34μ in greatest dimensions, four times longer than wide. Outer lateral seta 52μ, outermost terminal seta 70μ, innermost terminal seta 57μ. Two long median terminal setae 195μ (outer) and 380μ (inner) and inserted slightly dorsally. Dorsal pedicellate seta small, 18μ long. All setae naked. Dorsal surface of ramus without ornamentation.

Dorsal surface of prosome and urosome with a few hairs (as in fig. 1); ventral surface of urosome almost devoid of ornamentation. Ratio of length of prosome to that of urosome 1.4:1.

Egg sac unknown.

Rostrum (figs. 8, 9) a rounded prominence with a rather blunt posteroventral tip.

First antenna (fig. 10) slender (about 358μ in length) and 7-segmented, with a sclerite on third segment (fig. 11) suggesting an intercalary segment. Lengths of segments (measured along posterior nonsetiferous margins) 13μ (50μ along anterior margin), 81μ, 35μ, 60μ, 55μ, 41μ, and 36μ respectively. Formula for armature, as in many other lichomolgids, 4, 13, 6, 3, 4+1 aesthete, 2+1 aesthete, and 7+1 aesthete. All setae naked.

Second antenna (fig. 12) 4-segmented. Armature 1, 1, 3, and I,5. All setae naked. Three long terminal setae on last segment jointed; claw pale brown, 77μ along its axis. Second segment with few short spinules along outer edge.

Labrum (figs. 13, 18) with two widely divergent posteroventral lobes.

Mandible (fig. 14) with a slender elongated blade bearing spinules along each side. Paragnath (fig. 13) a small hairy lobe. First maxilla (fig. 15) with four setae (in one first maxilla of one female only three, seta nearest to two terminal ones being absent). Second maxilla (fig. 16) 2-segmented. First segment unornamented. Second segment having on outer (ventral) margin a small proximal seta, bearing on inner surface a seta with very short barbules and a long seta with spinules along one edge, and terminating in a long lash with long spinules on one margin and few small spinules on opposite side. Maxilliped (fig. 17) 3-segmented. First segment lacking spines or setae. Second segment with two rather unequal setae. Small third segment terminating in a spiniform process (not clearly articulated with segment) with a small seta near base. Postero-outer surface of second segment and postero-outer distal part of first segment with dense covering of fine short hairlike ornamentation.

Postoral area as in figure 18. Median region between mandibles, paragnaths, and first maxillae slightly protuberant. A sclerotized line between bases of maxillipeds.

Legs 1–4 (figs. 19–22) with trimerous rami. Armature as follows (Roman numerals indicating spines, Arabic numerals setae):

P_1	protopod	0–1	1–0	exp	I–0	I–1	III,I,4
				end	0–1	0–1	I,5
P_2	protopod	0–1	1–0	exp	I–0	I–1	III,I,5
				end	0–1	0–2	I,II,3
P_3	protopod	0–1	1–0	exp	I–0	I–1	III,I,5
				end	0–1	0–2	I,II,2
P_4	protopod	0–1	1–0	exp	I–0	I–1	II,I,5
				end	0–1	0–1	II

Inner margin of basis ornamented with spinules in leg 1, with hairs in legs 2–4. Leg 4 with last segment of exopod most often with the formula II,I,5 (in seven females), but occasionally III,I,5 (in two females) or II,I,5 and III,I,5 (in two females where formula differed on opposite legs). Last segment of endopod in leg 4 measuring 74μ x 28μ in greatest dimensions, with two terminal fringed spines 64μ (outer) and 79μ (inner).

Leg 5 (fig. 23) with its free segment 52μ x 19μ; ornamented with few minute distal outer spinules and armed with a terminal naked seta 77μ and a subterminal inner lamellate spine 33μ with blunt tip. Seta on body near insertion of free segment 36μ and naked.

Leg 6 probably represented by small seta and spiniform process near attachment of egg sac (see fig. 6).

Color in life in reflected light transparent to slightly amber, eye red.

MALE.—Body (figs. 24, 25) slender as in the female. Length (without setae on the caudal rami) 1.44 mm (1.22–1.54 mm) and greatest width 0.44 mm (0.38–0.50 mm), based on 10 specimens measured in lactic acid. Ratio of length to width of prosome 1.8:1.

Segment of leg 5 (fig. 26) 52μ x 109μ. Between this segment and genital segment no ventral intersegmental sclerite. Genital segment only slightly longer than wide, 255μ x 234μ, with lateral margins gently rounded in dorsal view. Four postgenital segments 52μ x 99μ, 55μ x 94μ, 49μ x 84μ, and 88μ x 81μ, from anterior to posterior.

Caudal ramus resembling that of female, 114μ x 29μ.

Surfaces of body ornamented with few hairs (fig. 24) as in female. Ratio of length of prosome to that of urosome 1.2:1.

Rostrum like that of female.

First antenna (fig. 27) resembling that of female, but with three aesthetes added, so that the formula is 4, 13 + 2 aesthetes, 6, 3 + 1 aesthete, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. Second antenna (fig. 28) similar to that of female, but with four elements on third segment and with small spinules along inner edge of second segment.

Labrum, mandible, paragnath, first maxilla, and second maxilla as in female. Maxilliped (fig. 29) slender and 4-segmented, assuming that proximal part of claw represents a fourth segment. First segment unarmed. Second segment bearing two inner setae, innermost with sclerotized basal portions (fig. 30), and row of spinules on posterior surface. Third segment small and unarmed. Recurved claw 172μ along axis, with slight indication of division about midway; terminal lamella very narrow; two unequal setae on proximal part of claw.

Postoral area as in female.

Legs 1–4 as in female, with same spine and setal formula. Last segment of endopod of leg 1 (fig. 31) showing very slight sexual dimorphism, with more numerous terminal spinules and outer fringe on spine more strongly spinulose than in female.

Leg 5 (fig. 32) with free segment 33μ x 13μ, terminal seta 62μ, and subterminal inner spine 15μ and without lamellae.

Leg 6 (fig. 33) a posteroventral flap on genital segment bearing two naked setae 29μ and 38μ long, with a row of minute spinules near insertion of longer more anterior seta.

Spermatophore not seen.

Color in life like that of female.

ETYMOLOGY.—The specific name *protothacae* is formed from the generic name of the host.

COMPARISON WITH RELATED SPECIES.—Following the views of Illg (1949) and adding information from Bocquet and Stock (1958, 1958a, 1959), Gotto (1961) regarded the genus *Paranthessius* as embracing 21 species. Stock (1964) has, however, removed six of these species to the genus *Scambicornus* Heegaard, 1944. These are *S. prehensilis* (Sars, 1918), *S. robustus* (Thompson and A. Scott, 1903), *S. serendibicus* (Thompson and A. Scott, 1903), *S. propinquus* (Nicholls, 1944), *S. finmarchicus* (T. Scott, 1903), and *S. tenuicaudis* (Sars, 1918). A recently described form, *P. colmani* Reddiah, 1960, must be added to the genus, bringing the number of currently recognized species to 16. For the purpose of the description of *P. protothacae* and the following new species, *Paranthessius* is held to consist of these 16 species, although it is recognized that many problems exist in the determination of the generic limits and that several authors (for example, Monod and Dollfus, 1932; Illg, 1949; Sewell, 1949; Bocquet and Stock, 1957; and Reddiah and Williamson, 1959) have variously interpreted the scope of the genus.

Nine species of *Paranthessius* have a distinct beak on the rostrum and may thus be distinguished readily from *P. protothacae*. These are: *P. columbiae* (Thompson, 1897); *P. panopeae* Illg, 1949; *P. tivelae* Illg, 1949; *P. nasutus* (Edwards, 1891); *P. pectinis* (Pesta,

1909); *P. rostratus* (Canu, 1891); *P. haploceras* Bocquet and Stock, 1959; *P. barneae* (Pelseneer, 1929); and *P. colmani* Reddiah, 1960.

The new species may be separated from the remaining seven species as follows: *P. anemoniae* Claus, 1889, has an elongated segment in leg 5 (about 5:1 in Bocquet and Stock, 1959a, fig. 5d) and the second antenna has three terminal claws; *P. cynthiae* (Brian, 1924) has the caudal ramus equal to the length of the last two postgenital segments and the last segment of the second antenna much longer than the penultimate segment; *P. myxicolae* Bocquet and Stock, 1958, has recurved spines on the first and second segments of the first antenna and three terminal claws on the second antenna; *P. parvus* (Norman and T. Scott, 1905) has jointed setae (no claw) on the last segment of the second antenna in the female; *P. perplexus* Illg, 1949, has an ellipsoid rounded process on each side of the genital segment in the female; *P. saxidomi* Illg, 1949, has a reduced maxilliped in the female (length less than half the basal segment of the second maxilla), the basis of legs 1–3 with stout spinules, the last segment of the endopod of leg 4 with the inner spine nearly 2.5 times the length of the outer spine, the segment of leg 5 in the female with a rounded expansion at the base and the two terminal elements subequal in length, the male maxilliped with a modified seta on the second segment, and the male genital segment with two pairs of rows of spinules; and *P. validus* (Sars, 1918) has a caudal ramus that in the female is only slightly longer than wide.

Paranthessius mesodesmatis, new species

FIGURES 34–43

TYPE MATERIAL.—14 ♀♀ and 16 ♂♂ from the mantle cavity of 39 *Mesodesma donacium* Lamarck purchased in the fish market at Valparaiso, Chile, Aug. 4, 1966. (These pelecypods presumably came from Viña del Mar, near Valparaiso.) Holotype female, allotype, and 24 paratypes (11 ♀♀, 13 ♂♂) deposited in the United States National Museum, and the remaining paratypes (dissected) in the collection of the author.

In the following description those features not mentioned may be assumed to be essentially like those of the previous species.

FEMALE.—Body (figs. 34, 35) with tumid prosome. Length (not including setae on caudal rami) 1.49 mm (1.40–1.63 mm) and greatest width 0.64 mm (0.48–0.77 mm), based on 8 specimens measured in lactic acid. Dorsoventral thickness of prosome about 0.66 mm in a specimen 1.50 x 0.64 mm. (One female less tumid than the others, its dimensions 1.47 x 0.47 mm, with dorsoventral thickness of 0.42 mm.) Ratio of length to width of prosome 1.38:1. Segment of leg 1 very

weakly delimited from head. Epimeral areas of first and second metasomal segments apparently distorted by swelling of prosome (fig. 34).

Segment of leg 5 (fig. 36) 69μ x 133μ. Genital segment 195μ x 190μ. Areas of attachment of egg sacs dorsolateral. Three postgenital segments 73μ x 104μ, 57μ x 91μ, and 91μ x 86μ, from anterior to posterior. Caudal ramus 102μ x 30μ, 3.4 times longer than wide, slightly shorter than in *P. protothacae*.

Ratio of length of prosome to that of urosome 1.5:1.

Egg sac (fig. 34) elongated, 1.25 x 0.26 mm in one female, 1.73 x 0.29 mm in another, with many eggs each about 86μ in diameter.

Rostrum (fig. 37) as in previous species.

First antenna segmented and armed as in *P. protothacae*, but shorter, about 285μ long. Lengths of segments (measured along posterior nonsetiferous margins) 16μ (42μ along anterior margin), 61μ, 25μ, 51μ, 43μ, 36μ, and 27μ respectively. All setae naked.

Second antenna segmented and armed as in *P. protothacae*. Claw 59μ along axis.

Labrum, mandible, paragnath, first maxilla, and second maxilla as in *P. protothacae*. Maxilliped resembling that of previous species, but the two setae on second segment more nearly equal and fine hairlike ornamentation on first two segments apparently absent.

Postoral area as in previous species.

Legs 1–4 segmented and armed as in *P. protothacae*. Outer edge of first segment of exopod of leg 1 without small spinules. Last segment of exopod of leg 4 with the formula II,I,5 in each of 10 females. Last segment of endopod of leg 4 (fig. 38) shaped as in previous species but shorter, 57μ x 24μ, its two terminal spines 44μ (outer) and 60μ (inner) in length.

Leg 5 (fig. 39) with the free segment 43μ x 16μ, ornamented with a small distal outer spinule, terminal seta 50μ, and subterminal spine 18μ with narrow lamellae.

Leg 6 as in *P. protothacae*.

Color in life in reflected light slightly amber, eye pale red, egg sacs whitish opaque.

MALE.—Body form much like that of male of *P. protothacae*, as shown in figures 24, 25. Prosome not tumid. Length (without the ramal setae) 1.38 mm (1.25–1.50 mm) and greatest width 0.44 mm (0.39–0.48 mm), based on 10 specimens measured in lactic acid.

Genital segment (fig. 40) 260μ x 252μ. Four postgenital segments 69μ x 99μ, 69μ x 94μ, 51μ x 81μ, and 92μ x 79μ, from anterior to posterior.

Caudal ramus like that of female, 101μ x 30μ.

Rostrum similar to that of female. First antenna 297μ long, segmented and armed as in male of *P. protothacae*. Second antenna as

in male of previous species. Labrum, mandible, paragnath, first maxilla, and second maxilla like those of the female. Maxilliped resembling that in *P. protothacae*, but claw 150μ along axis, and sclerotization of innermost seta on the second segment slightly different (fig. 41).

Postoral area as in female.

Legs 1–4 segmented and armed as in female. Last segment of endopod of leg 1 (fig. 42) with terminal spinules slightly coarser than in female.

Leg 5 (fig. 43) with the free segment 32μ x 14μ, without ornamentation, terminal seta 55μ, and subterminal spine 10μ, slender and setiform, without lamellae.

Leg 6 as in *P. protothacae*, the two setae 31μ and 44μ in length.

Spermatophore not seen.

Color in life in reflected light opaque white, eye pale red.

ETYMOLOGY.—The specific name *mesodesmatis* is formed from the generic name of the host.

COMPARISON WITH RELATED SPECIES.—*P. mesodesmatis* is very close to *P. protothacae*, but differs from it in several features. In *P. mesodesmatis* the prosome of the female is swollen, the ratio of length to width of the caudal ramus is 3.4:1 (instead of 4:1 as in *P. protothacae*), the first antennae are distinctly shorter, and certain other parts are relatively smaller as shown below.

Comparison of certain features of *Paranthessius protothacae* and *P. mesodesmatis* is as follows:

	P. protothacae	*P. mesodesmatis*
FEMALE		
Body size	1.62 x 0.54 mm	1.49 x 0.64 mm
Ratio of length to width of prosome	1.9:1	1.38:1
Nature of prosome	not tumid	tumid in nearly all specimens
Caudal ramus	135μ x 34μ (4:1)	102μ x 30μ (3.4:1)
Length of first antenna	358μ	285μ
Length of claw on second antenna	77μ	59μ
Formula for last segment of exopod of leg 4	usually II,I,5, but sometimes III,I,5	always II,I,5
Last segment of endopod of leg 4	74μ x 28μ	57μ x 24μ
Segment of leg 5 and two terminal elements	52μ x 19μ, seta 77μ, spine 33μ	43μ x 16μ, seta 50μ, spine 18μ
MALE		
Body size	1.44 x 0.44 mm	1.38 x 0.44 mm
Claw of maxilliped	172μ	150μ
Terminal spinules on last segment of endopod of leg 1	slender	coarse
Subterminal element of leg 5	15μ, spiniform	10μ, setiform

The differences observed between these two new species appear to be constant among the specimens studied, without overlap. The swollen prosome in the female of *P. mesodesmatis* occurred in both ovigerous and nonovigerous specimens. Bocquet and Stock (1959) stated that the prosome in *Paranthessius* tends to become larger and more swollen with the age of the females, doubtless because of the pressure exerted by the ovaries. In the preserved specimens of *P. mesodesmatis* it was impossible to separate the females by age since there was no way of being certain that egg sacs in some cases had not accidentally been broken off. The single less tumid mature female mentioned above may represent an individual that had not yet produced egg sacs.

269-426—67——2

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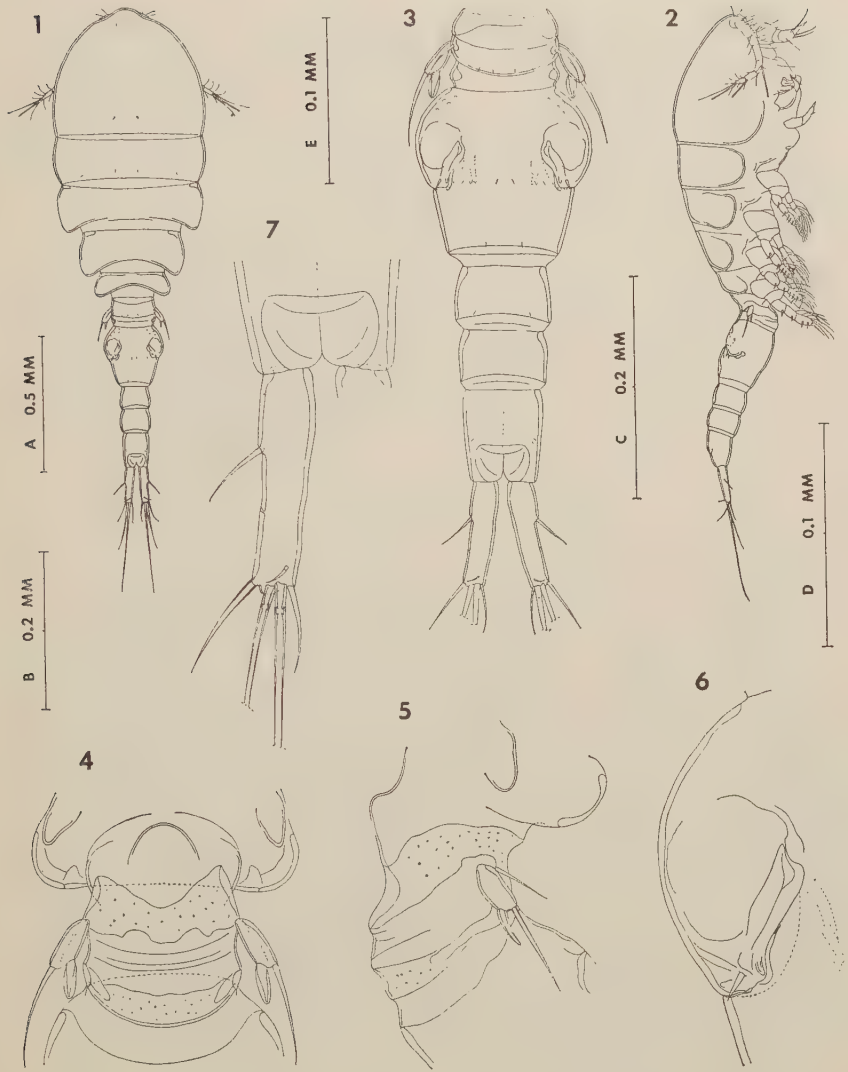
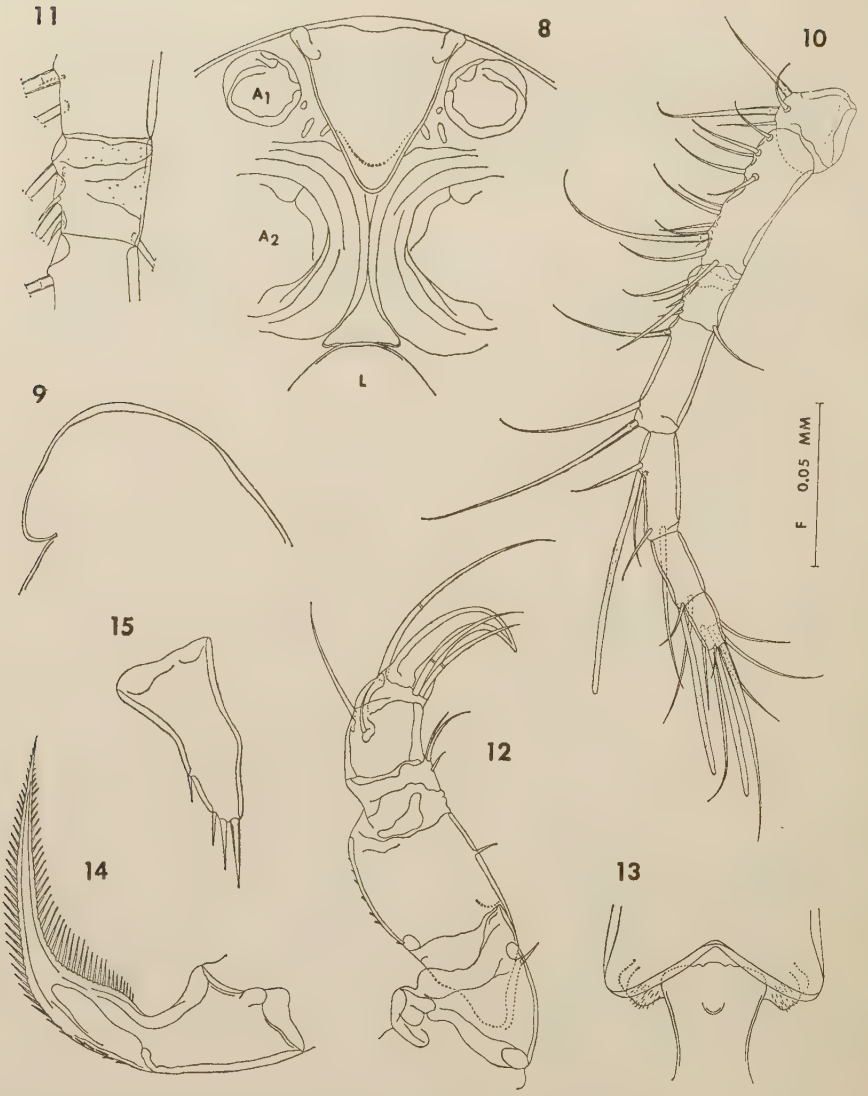
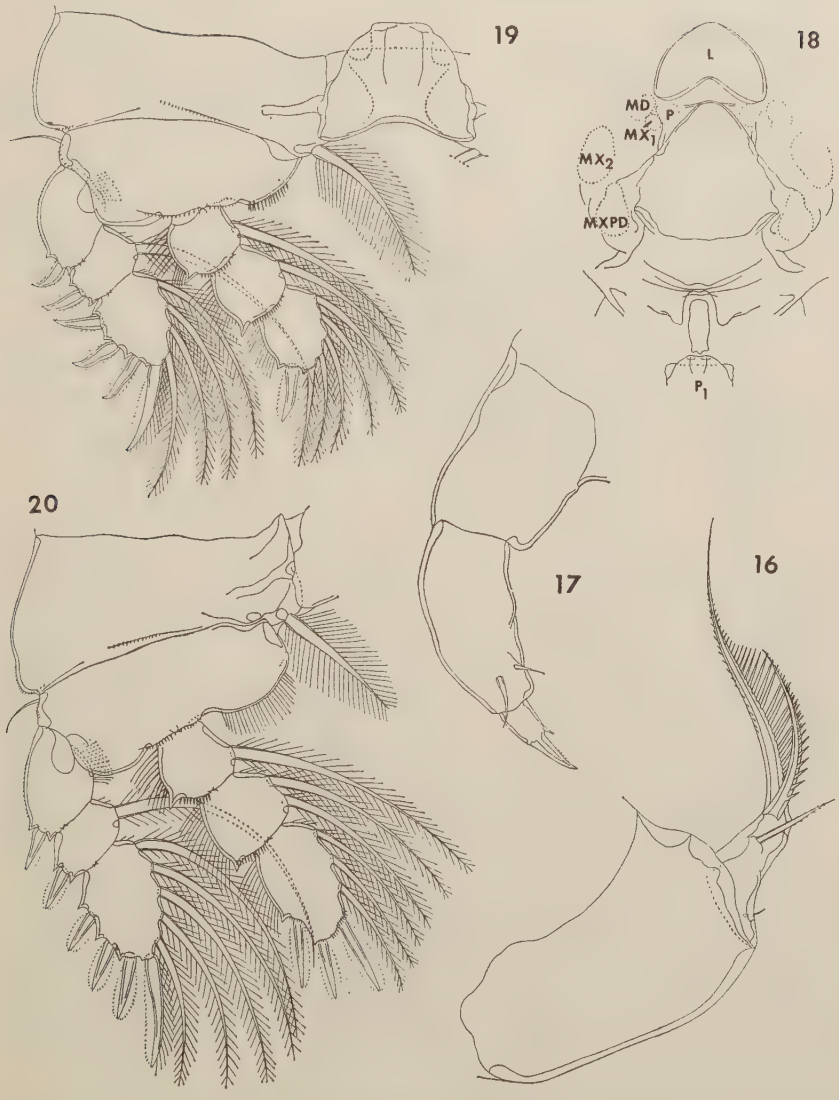


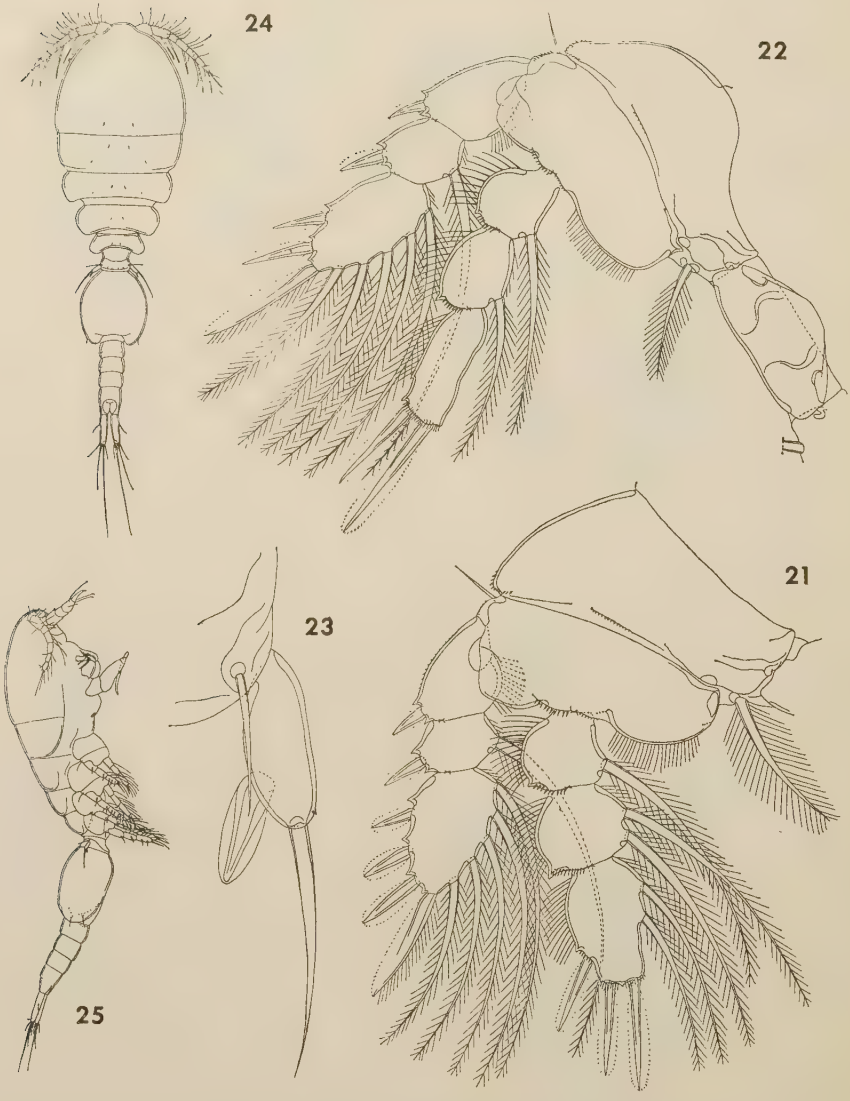
FIGURES 1–7.—*Paranthessius protothacae*, new species, female: 1, body, dorsal (A); 2, body, lateral (A); 3, urosome, dorsal (B); 4, segments of legs 4 and 5, ventral (C); 5, segments of legs 4 and 5, lateral (C); 6, area of attachment of egg sac, dorsal (D); 7, caudal ramus, dorsal (E).



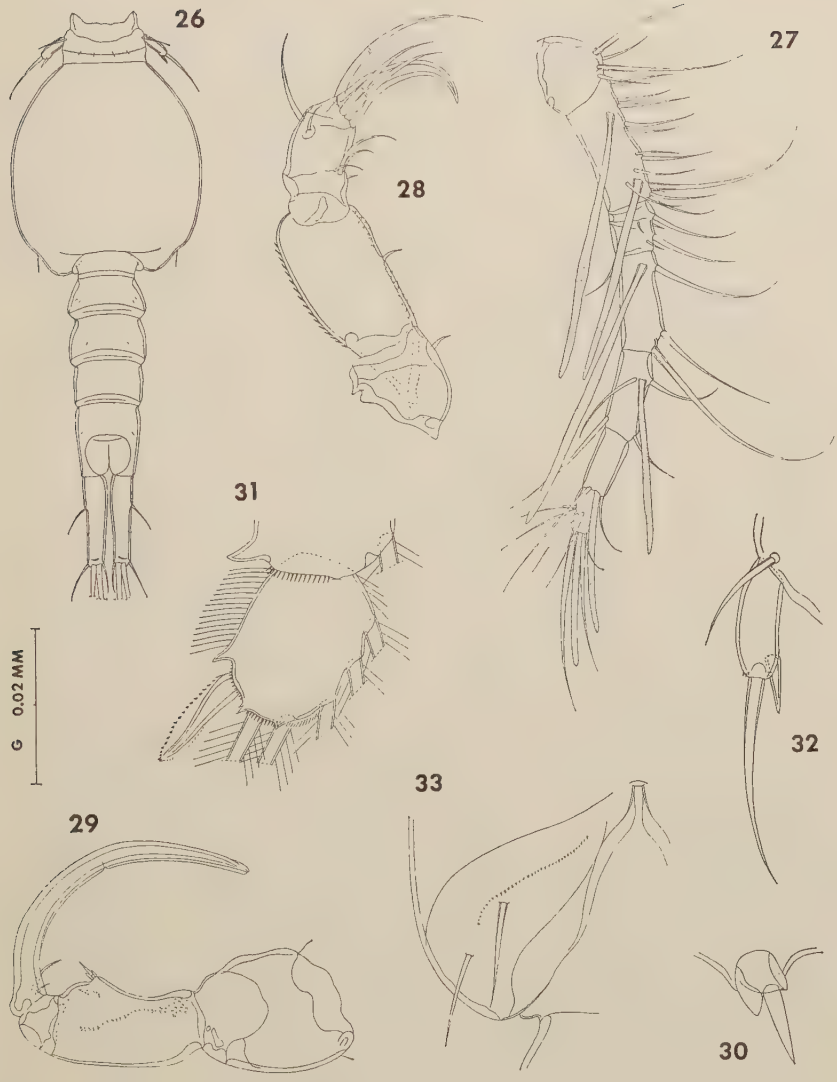
FIGURES 8–15.—*Paranthessius protothacae*, new species, female: 8, rostrum, ventral (E); 9, outline of rostrum, lateral (E); 10, first antenna, dorsal (E); 11, third segment of first antenna, ventral (F); 12, second antenna, posterior (E); 13, edge of labrum, paragnaths, and lingua, ventral (E); 14, mandible, posterior (F); 15, first maxilla, anterior (F).



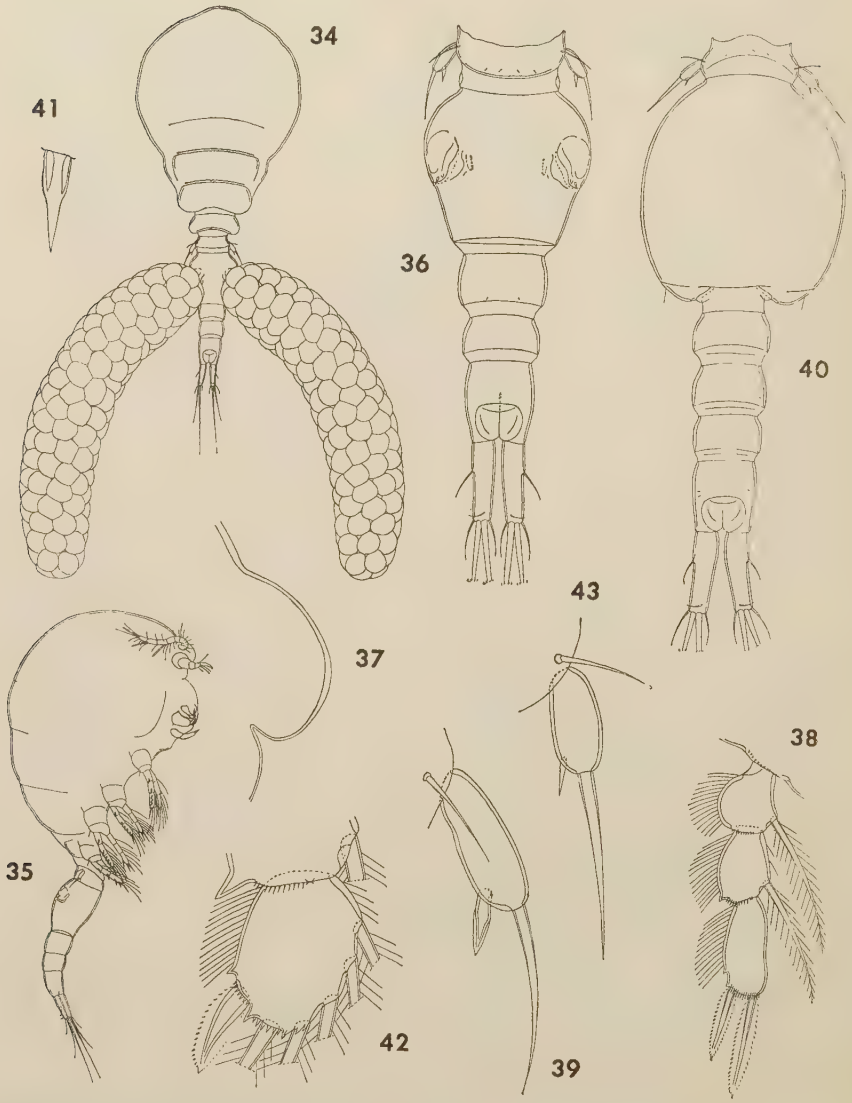
FIGURES 16–20.—*Paranthessius protothacae*, new species, female: 16, second maxilla, inner (F); 17, maxilliped, antero-inner (F); 18, oral and postoral area, ventral (B); 19, leg 1, anterior (E); 20, leg 2, anterior (E).



FIGURES 21–25.—*Paranthessius protothacae*, new species, female: 21, leg 3, anterior (E); 22 leg 4, anterior (E); 23, leg 5, dorsal (F). Male: 24, body, dorsal (A); 25, body, lateral (A).



FIGURES 26–33.—*Paranthessius protothacae*, new species, male: 26, urosome, dorsal (B); 27, first antenna, ventral (E); 28, second antenna, posterior (E); 29, maxilliped, anterior (E); 30, innermost seta on second segment of maxilliped, posterior (G); 31, last segment of endopod of leg 1, anterior (F); 32, leg 5, dorsal (F); 33, leg 6, ventral (E).



FIGURES 34–43.—*Paranthessius mesodesmatis*, new species, female: 34, body, dorsal (A); 35 body, lateral (A); 36, urosome, dorsal (B); 37, outline of rostrum, lateral (E); 38, endopod of leg 4, anterior (E); 39, leg 5, dorsal (F). Male: 40, urosome, dorsal (B); 41, innermost seta on second segment of maxilliped, inner (G); 42, last segment of endopod of leg 1, anterior (F); 43, leg 5, dorsal (F).

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